Modelling the Trans-placental Transfer of Maternal Antibodies

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How does the placenta provide immune protection?

The transport and exchange of nutrients via the placenta is crucial for healthy fetal development.

The active transfer of maternal antibodies from mother to fetus provides immune protection for the neonate in early life and is mediated by the neonatal Fc receptor, FcRn.

Maternal antibodies (IgG) transfer across the placenta at different efficiencies depending on their characteristics, but we do not fully understand why.

Why are maternal vaccinations important?

Transferred immunity to the fetus can be boosted by maternal vaccination strategies.

Mother with low antibody

Vaccinated mother

Transfer Ratio

24h B/A Ratio

Test Result (ng/mL)

Infant vaccination

Maternal vaccination

Hypothesis:

There are specific molecular features that define the efficiency of placental antibody transport.

Project Aim:

To develop and utilise in vitro models to study the determinants of natural and engineered antibody transfer across the human placenta.

Design your own antibody transfer model

Current placental transfer models, including the perfusion model, are technically challenging and low throughput. Rodent animal models are not physiologically relevant to the human placenta, therefore, there is a need for in vitro models to assess the determinants of trans-placental antibody transfer.

1. Choose the Cells

- Cell line:
  - Less physiologically relevant
  - Lack expression of FcRn
  - Immortalised cell line

- Trophoblast Stem Cells

2. Choose the Model

- Transwell

- Placenta-on-a-chip

- 3D growth of cells
- Co-culture and compartmentalise different cell types
- Mimic interfaces
- Fluidic environment

3. Determine in vitro Antibody Transfer

Transfer Ratio

Impact for pregnant women and their babies

Modelling the determinants of antibody transfer at the maternal-fetal interface is crucial to guide the optimal design of future vaccine and antibody therapeutics for pregnant women and their babies.